PCT / SE 2004 / 001977

PRV

PATENT- OCH REGISTRERINGSVERKET
Patentavdelningen

Intyg
Certificate

Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

PATENT- OCH REGISTRERINGSVERKET • PATENT- OCH REGISTRERINGSVERKET

(71) *Sökande* / *Applicant (s)* — *Telefonaktiebolaget L M Ericsson (publ), Stockholm SE*

(21) *Patentansökningsnummer* / *Patent application number* — *0400339-8*

(86) *Ingivningsdatum* / *Date of filing* — *2004-02-11*

Stockholm, 2004-12-29

För Patent- och registreringsverket
For the Patent- and Registration Office

Gunilla Larsson

Avgift
Fee

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

PATENT- OCH REGISTRERINGSVERKET
SWEDEN

Postadress/Adress
Box 5055
S-102 42 STOCKHOLM

Telefon/Phone
+46 8 782 25 00
Vx 08-782 25 00

Telex
17978
PATOREG S

Telefax
+46 8 666 02 86
08-666 02 86

Mobility handling of user equipments in URA_PCH state for MBMS

FIELD OF THE INVENTION

The present invention relates to a method for supporting mobility of URA_PCH UEs with respect to MBMS services.

BACKGROUND OF THE INVENTION

The work item Multimedia Broadcast Multicast Service (MBMS) is currently being standardised for release 6 within 3GPP. There are two modes of point-to-multipoint (ptm) operation defined, the broadcast and the multicast mode. This invention relates to the multicast mode and the notification and counting of UEs in URA_PCH state.

The specifications require that it shall be possible for a UE that has previously joined an MBMS service to receive this service at session start, as long as it remains in the multicast area and has sufficient UE capabilities.

However, in current specifications or discussions on MBMS, no mechanism has yet been defined for providing a notification at session start to a UE in URA_PCH state in case the URA (UTRAN Registration Area) that the UE is located in also contains cells that do not belong to the S-RNC.

Furthermore, counting of UEs in URA_PCH state is not clearly defined. Since it is possible to count UEs in all other

states at session start mechanisms for counting of URA_PCH UEs shall also be provided.

DESCRIPTION OF THE INVENTION

In case the UE is in URA_PCH state, current architecture assumes that no UE context exists in the drift RNC. It is only the Serving RNC that knows where, i.e. in which URA, the UE is.

Also it is allowed to have URAs that span over cells that belong to different RNCs. In normal operation according to the state of the art a UE in URA_PCH state can move around between cells that belong to the same URA without indicating to the network that it is located in a different cell. It is only in case it moves into a cell that does not belong to the URA that is currently allocated to this UE that it sends a message to the network indicating that it has changed its location. This message is the URA UPDATE message.

The problems could be illustrated with the following example: Cell 1, 2 and 3 belong to RNC1. Cell 4 and 5 to RNC2. Cell 1, 2, 3 and 4 corresponds to URA1 and Cell 3, 4 and 5 corresponds to URA2. If a UE starts in Cell2, has RNC1 as its S-RNC and is moved to URA_PCH state belonging to URA1, the UE can move between Cell 1-4 without sending any message (URA UPDATE) to the network (RNC1). However, if it moves to Cell5 it will send the URA UPDATE message.

If now this UE has joined an MBMS service, it needs to get the notification of session start and to be counted if it remains within the MBMS multi-cast area (it is assumed here that all cells belong to the multi-cast area.) The counting is used by the controlling RNC to decide whether the

transmission of MBMS data in a cell shall be done via point-to-point (ptp) or point-to-multipoint (ptm).

Three problems can be foreseen: A first problem relates to "Missed notification in DRNC". If the UE moves to Cell4 it will not send any URA UPDATE message. At the same time if RNC1 receives a session start it will send a notification of this in a broadcast manner on the MCCH in all cells belonging to RNC1. However, since the UE is in Cell4 it will not receive this notification from RNC1. Also in case there are no other known (from RNC2s point of view) MBMS UE for this MBMS service in Cell4 RNC2 will not send a notification in this cell. This because RNC2 has no knowledge about this UE that only has a context in RNC1 (which is the SRNC). Therefore there is a risk that Ues in URA_PCH state miss the notification of an MBMS session, and fail to receive the service.

A second problem relates to "Failed counting in DRNC". If the UE moves to Cell4 it will not send any URA UPDATE message. Also there is no stored UE context for this UE in RNC2. In the case where session start is however received by RNC2 (i.e. due to other joined MBMS UEs), RNC2 may initiate a counting procedure in order to base its ptm/ptp decision on the amount of joined UEs in this cell. Connected mode UEs are counted by counting the MBMS UE contexts stored for the UEs that are located in this cell. Idle mode UEs are counted with a counting procedure where a certain fraction send a RRC CONNECTION REQUEST message and transit to RRC connected mode. If the number of UEs is high enough in this cell, ptm transmission is used. However, the UE that moved to Cell4 in URA_PCH state will not be counted with any of these existing methods. RNC2 has no context for this UE and the UE will not respond to the idle mode counting. Therefore there is a risk

that an erroneous ptp to ptm decision is taken in RNC2 for Cell4, leading to waste of radio resources.

A third problem relates to "Paging load". As previously stated, UEs in URA_PCH state shall be notified of the session start. In case Iur linking is not performed, notification shall necessarily be performed by RNC1 via dedicated paging (i.e. on DCCH), as RNC2 has no knowledge of URA_PCH UEs for which it is not the serving RNC. However, it is foreseeable that dedicated paging would entail heavy load on the Iur and Uu interfaces. In case of overload, paging messages could be lost/discarded in the network, thus leading the UE in URA_PCH state to miss the notification.

The following describes the basic concept of the present invention: In order for URA_PCH UEs to be alerted of session start when moving into a CRNC/DRNC area, an Iur linking procedure is introduced, initiated by the serving RNC. This procedure provides all necessary MBMS information to the CRNC/DRNC (note that in the remaining of this document, the RNC (different from SRNC) controlling the cell in which the UE in URA_PCH state is located is referred as CRNC/DRNC). Furthermore, several procedures enabling the CRNC/DRNC to perform counting of UEs in URA_PCH state are described, each mechanism being optimized for a given amount of UEs to be counted.

In the proposed scheme, the SRNC shall transmit an MBMS ATTACH REQUEST message, e.g. as to be described in RNSAP specification 25.423, to all drift RNCs controlling at least one cell in the URA entered by the UE, either upon receipt of URA UPDATE, e.g. as described in 25.331, (new URA) from the UE, or at transition to URA_PCH state from any other UE RRC state (early linking), or upon receipt of SESSION START (as to be described in RANAP specification 25.413) (late linking).

The SRNC shall include following information in the MBMS ATTACH REQUEST message:

- Joined MBMS services ID
- URA ID
- U-RNTI, IMSI, UTRAN DRX Cycle Length

Upon receipt of MBMS ATTACH REQUEST message for a UE in URA_PCH state, the CRNC/DRNC shall:

- create an MBMS UE context, and store information included in the received message into this context
- (if needed) create an MBMS service context and register towards the upstream SGSN. The MBMS service ID and the U-RNTI shall be included in this context.

This will make it possible for the CRNC/DRNC to notify the UE in URA_PCH state about the MBMS session start and provides a solution to the first and third problem.

Note that the SRNC would be responsible for updating the MBMS UE context whenever the URA_PCH UE would move to a new URA (3GPP TS 25.346 MBMS ATTACH REQUEST).

Furthermore, the MBMS UE context (and possibly the MBMS service context, in case no RRC connected UEs joined to the MBMS service remain in the RNC area) would be deleted in the CRNC/DRNC whenever the URA_PCH UE would move to a URA entirely comprised in another RNC area. In this case, the SRNC would transmit TS 25.346 MBMS DETACH REQUEST to the CRNC/DRNC.

Also at session start, the CRNC/DRNC may decide to perform counting of URA_PCH UEs, i.e. to find out the exact location of such UEs (on a cell level). This is facilitated due to the contexts created for URA_PCH UEs in the CRNC/DRNC.

Several applicable strategies may be used by the CRNC/DRNC (note that in all these strategies, CELL UPDATE and CELL UPDATE CONFIRM messages are used, but it could as well be any other UE uplink message, e.g. a specific MBMS message.)

a) The CRNC/DRNC pages the URA_PCH UEs individually, utilizing the information stored in the MBMS UE context (one for each UE). Upon receipt of the paging message, the URA_PCH UE shall respond with a CELL UPDATE message indicating either a special cause value e.g. "respond to MBMS counting" (assuming the UE can link paging to MBMS notification) or any of the existing cause values, e.g. "paging response". Both alternatives could be seen as equally useful.

In this case, it is foreseen that the SRNC would send back the UE to URA_PCH; however, the CRNC/DRNC would now have the information in which cell the UE is located. Even though this information may quickly become out of date, it is however assumed that this procedure would provide reliable input for counting purpose. Note that this procedure is mainly applicable when the amount of URA_PCH UEs is kept low.

b) The CRNC/DRNC includes "URA_PCH specific paging information" in the MBMS NOTIFICATION message broadcasted on MCCH. Indeed, UEs in URA_PCH state are notified of incoming MBMS calls either on MICH (no ptm session ongoing) or get notified on MTCH (ongoing ptm session), after which they are mandated to read the MCCH. The "URA_PCH specific paging information" would include a probability factor: by drawing a random number and using the received probability factor, the UE may decide to transmit a CELL UPDATE to the CRNC/DRNC (with a specific MBMS cause value, eg. "MBMS counting"). The "URA_PCH specific paging information" could either be related to URA_PCH mobiles only, the information sent to idle mode UEs could be used as well for URA_PCH UEs.

Note that the UE would stay in URA_PCH state during this procedure, and as a consequence the CRNC/DRNC would not forward the message to the SRNC. Instead, the procedure would be terminated, and no CELL UPDATE CONFIRM would be sent back to the UE. Again, it is assumed that this procedure would provide reliable input for counting purpose, even though the location information may quickly be out of date. Also since the CELL UPDATE message is sent in unacknowledged mode some of these messages will be lost and the UE will not re-

send the message after a certain time. This procedure is applicable irrespective of the amount of URA_PCH UEs to be counted, however, it is assumed that it would be used when the number of URA_PCH UEs is neither too low, nor too high.

c) This is very similar to (a) and the CRNC/DRNC pages the URA_PCH UEs individually as in (a), and the UE responds with a CELL UPDATE message as in (a). However, the individual page message includes a special cause value e.g. "MBMS counting" so that the UE knows that this page is only done for counting.

However, instead of sending the CELL UPDATE message to the SRNC as in (a) the UE transits directly back to URA_PCH state as in (b). Also the same inaccuracy due to mobility and lost CELL UPDATE messages as mentioned in (b) would also apply here. Note that this procedure is mainly applicable when the amount of URA_PCH UEs is kept low.

d) The DRNC applies a homogeneous probability factor for the UE in each cell. For instance, if the URA comprises N cells, a URA_PCH UE could be counted as 1/N in each cell. This method is obviously applicable when the number of UES in URA_PCH state is large, thus allowing statistical averaging over all cells. Several other functions as compared to 1/N could be used, e.g. taking into account the cell where the UE did its last uplink message, and the time since when this was done, etc.

A combination of measures (a) to (d), or (a) to (d) on their own, provides solutions to the second problem.